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High precision neodymium isotopic analysis of chondrites with complete sample digestion

FUKAI, Ryota[1*] ; YOKOYAMA, Tetsuya[1] ; KAGAMI, Saya[1]

[1]Department of Earth and Planetary Sciences, Tokyo Institute of Technology

A variety of isotope anomalies have been discovered in bulk chondrites and differentiated meteorites (e.g., Cr, Mo [1, 2]). These results point to the existence of planetary-scale isotope heterogeneities for refractory heavy elements, which are most likely due to the heterogeneous distribution of presolar grains (e.g., SiC, graphite) in the protosolar nebula before the onset of planetesimal formation.

High precision Nd isotope analyses in meteorites have been the center of interest in recent cosmochemistry community. One of the most remarkable results is that chondrites possess $^{142}Nd/^{144}Nd$ ratios ~20 ppm lower than those in terrestrial rocks [3]. The anomaly was interpreted to be caused by the Sm-Nd fractionation via early differentiation of the terrestrial mantle. On the other hand, variations in stable Nd isotopes (e.g., $^{148,150}Nd/^{144}Nd$) have been documented in chondrites [4]. Although the authors concluded that the observed variation was due to incomplete digestion of presolar grain-bearing samples, the existence of Nd isotope anomalies in bulk aliquots of chondrites remains unclear unless high precision Nd isotope data with complete sample digestion become available.

In this study, we revisit high precision Nd isotope analysis of chondrites coupled with a new sample digestion technique that confirms complete dissolution of acid resistant presolar grains. We also develop a modified dynamic multicollection method using TIMS to improve the analytical reproducibilities.

We investigated two carbonaceous chondrites (Murchison, CM2; Allende, CV3), five ordinary chondrites (Kesen, H4; Chergach, H5; Saratov, L4; Hamlet, LL4; St.Severlin, LL6). The ordinary and Rumuruti chondrites with a petrologic grade greater than 3 were dissolved by a conventional acid digestion method using HNO_3 + HF + $HClO_4$ [5]. For carbonaceous chondrites, each sample was digested using a high-pressure digestion system (DAB-2, Berghof) with HF + HNO_3 + H_2SO_4 to completely dissolve acid resistant presolar grains [6].

The Nd isotope compositions were measured by TIMS (Triton-plus, Tokyo Tech). In previous studies, Nd isotope compositions of bulk meteorites have been commonly measured in the “static-multicollection” mode, which may be affected by the time-related deterioration of Faraday cups [7]. In contrast, the “multi-static” [8] or “dynamic-multicollection” methods can reduce the effect of cup deterioration by acquiring Nd isotopes with multiple lines of different cup configurations within a single analytical cycle. In this study, we developed a modified “dynamic-multicollection” method.

In contrast to the static mode, the dynamic method achieved improved reproducibilities as follows; $^{142}Nd/^{144}Nd$: 2.8 ppm, $^{148}Nd/^{144}Nd$: 4.5 ppm, and $^{150}Nd/^{144}Nd$: 9.2 ppm. It should be noted that improvements of reproducibilities are evident for $^{148}Nd/^{144}Nd$ and $^{150}Nd/^{144}Nd$ ratios even compared to those obtained in the multi-static method (6 ppm and 19 ppm, respectively) conducted in [8].

All samples have $\mu^{142}Nd$ values 20 – 30 ppm lower than the terrestrial value. In contrast, all but one sample (Allende) have $\mu^{148}Nd$ values indistinguishable from the terrestrial value. Likewise, $\mu^{150}Nd$ values in chondrites are generally within the range of the terrestrial component. Although the data points are limited, this study suggests that stable Nd isotopes were homogenously distributed in the protosolar nebula, at least for carbonaceous, ordinary, and Rumuruti chondrites.

References: [1] Trinquier, A. et al. (2007) *ApJ*, *655*, 1179. [2] Burkhardt, C. et al. (2011) *EPSL*, *312*, 390. [3] Boyet, M. and Carlson, R. (2005) *Science*, *309*, 576. [4] Carlson, R. et al. (2007) *Science*, *316*, 1175. [5] T. Yokoyama et al. (1999) *Chem Geol.*, *157*, 175. [6] T. Yokoyama et al. (2015) *EPSL*, *in press*. [7] Brandon, A. et al. (2009) *GCA*, *73*, 6421. [8] Caro, G. et al. (2006) *Geochim*, *70*, 164.

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